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Design and development of electronic jacquard for Korai mat weaving loom

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A low-cost computerised mat weaving handloom has been developed. After successful field trials at the client locations, 300% increase in productivity is observed. Now any weaver can weave mat of any design within 2 days instead of 6-8 days, increasing their earning per mat. Easy to use pedalling mechanism, electronic jacquard and the software tool are developed. This innovation facilitates electronic design storage, eliminates recurring cost on punched cards and the weaver dependence on designers while weaving marriage mats. The well designed pedalling and jacquard lifting mechanism results in better ergonomics. The system is designed to operate with power of just 75 watt, so that it can be driven by solar power.

Keywords: Electronic jacquard, Fine Korai mat, Handloom, Weaving, Pathamadai Pai

Pattamadai Pattu Pai (mat) is a beautifully crafted floor mat. It is world famous for its silken mats woven from Korai grass. The Korai grass is split and used for exceptionally fine mats. It has a good market in India and abroad. Apart from the regular weaves and patterns, Pattamadai Pattu Pai are made to order for wedding ceremonies. The bride's name, the groom's names and the wedding date are woven into the mat to make the occasion memorable. This particular handicraft is originated from Pattamadai, a small village in Thirunelveli district of Tamil Nadu, India and hence its name. It is also called Korai or Gorai paai as it is made of a special kind of grass called Korai/Gorai. Korai grass grows in swampy lands and riverbeds. It is grown along the banks of the river Tamaraparani. These pais are ideal for hot and humid climates and most importantly are eco-friendly (with natural dyes)[1,2].

The prevalent primitive technology of thread by thread lifting process in weaving mats embedded with designs is time consuming and painstaking. Over the years, traditional designs are giving way to contemporary patterns, designs and custom motifs. Technology Development in fine Korai mat weaving for the benefit of Korai mat weavers is taken up in this study, with the main objective of improving ergonomics, increased productivity and enhancing the design capability.

Electronic Jacquard of 192 Hooks has been developed in this study to replace mechanical jacquard for fine Korai mat weaving using handloom of 40" reed width to enhance the design capability of fine Korai mat weaving, apart from deriving many benefits such as increased productivity with ease of operation, reduction in recurring cost of design development, elimination of card punching for the design, endless storage and ease of retrieval of design.

Marriage mat is one of the important products of fine Korai mat, where bride's name, bride-groom's name and date of marriage apart from the word "WEDS" appears as woven design. Handloom and powerloom weavers use the services of established designers towards the development of cards for jacquard design and they can produce large number of mats for a given design resulting in reduction of the design-development cost. In case of marriage mat they can weave only one or two mats maximum, which increases the cost of outsourced design development. This calls for a need to design and develop electronic jacquard and a software for composing names and date in bitmap (bmp) format from the bitmap (bmp) files of individual letters (A - Z) and individual numbers (0 - 9). This could be used by the weaver in house, to compose the names and marriage date according to the requirement of individual mat order and save the recurring expenses for design development.

Experimental

Mechanical Fabrication for Electronic Jacquard

The Korai mat weaving handloom used for mounting electronic jacquard has following specification: finished mat dimension 72 × 36 inch; loom dimension (with jacquard mounting) in L × W × H 84 × 62 × 114 inch; reed 40 inch; reed count 10s; total ends in a warp 184; ends per inch 5; and picks per inch 42-48.

The weight of a Lingos used is 50 g. The gross average weight of lifted hooks is around 5-6 kg. The permissible gross weight of 192 hooks electronic jacquard mechanism is 60 kg for safe loading on the existing wooden frame of the loom and to achieve smooth pedaling. The design of mechanical fabrication (Fig. 1) allows lifting of hooks using the twin pedal system; lift being 4 inch. Choice of pedal system is taken to reduce the cost of equipment and the power consumption [3].

Oscillating twin pedal system along with crank shaft is designed for opposite linear lifting operations of hooks. There are two lifting knives connected via chain that rests on a sprocket fixed on crank shaft. Two cranks are located at 180^0 out of phase to facilitate opposite movement of blades, when one blade is pressed positively by the leg.

Results and Discussion

Design to Module Mapping and Electronics Design

Each mat design (bitmap image, .bmp file) represents a grid of pixels. The arrangement of magnet modules, mapping of pixels in design to hooks and their numbering in electronic jacquard is shown in Fig. 2.

The 192 pixels of every line in the mat design correspond to 192 hooks of the jacquard. 24 Staubli type M5 magnet modules (24 × 8 = 192) are used to control the lifting of hooks. The modules are arranged linearly as the width of the loom accommodates all in the same line. This arrangement, as shown in Figs 1 and 2, simplifies mechanical design and improves harnessing. Electronic jacquard control system (EJCS) is developed for providing signals according to the lifting pattern stored in SD card (electronic

Fig. 1 — Fabrication of electronic jacquard

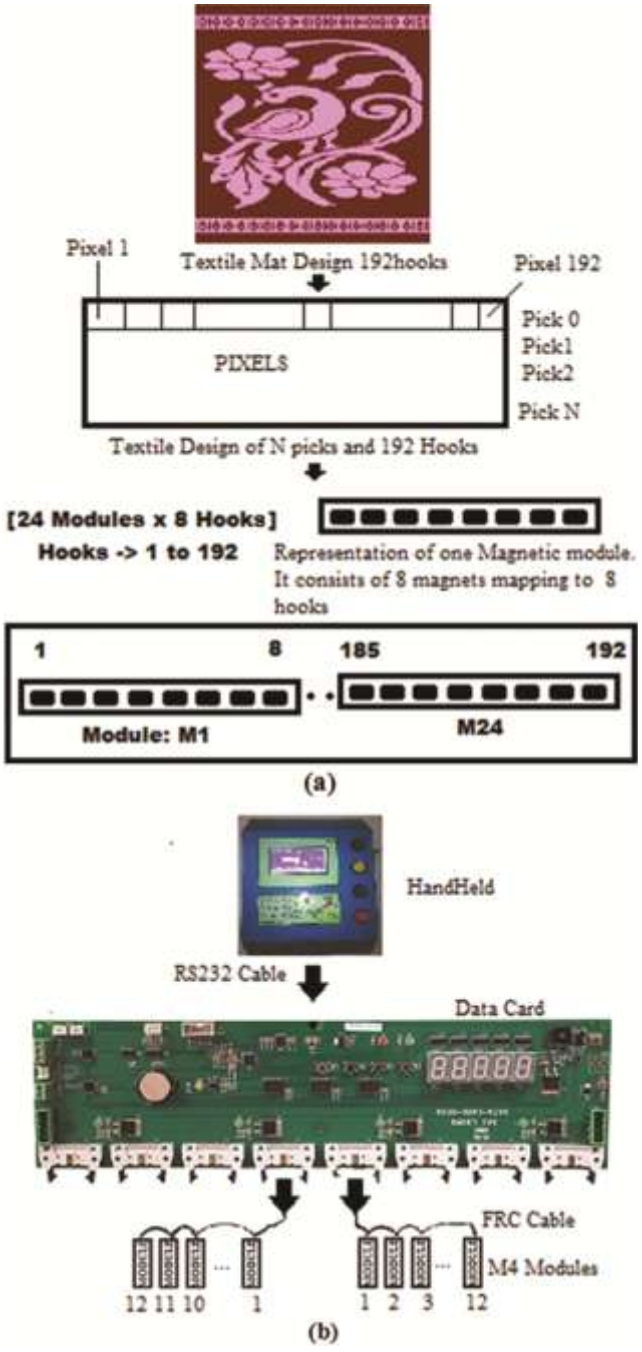

Fig. 2 — (a) Mapping design pixels to hooks and (b) handheld to datacard and leg arrangements

memory unit). The design details are already discussed in earlier publication[4].

Handheld – weaver control panel is provided for weaver interaction with the electronic jacquard as shown in Fig. 2(a). Copying, selection and running of mat design file is performed using intuitively designed GUI based interface. Data controller card connected to handheld drives the array of magnet modules. Handheld transfers the complete mat design to the data card, which, in turn, generates the design data to the magnets, located in the modules for every pick as the weaver performs the pedaling action. Inductive proximity sensor located near crank shaft senses the pedaling movements.

Data controller card used has 8 legs, each leg drives 12 modules (12 × 8 = 96 hooks). Leg 3 & 4 located at the center to the card are used (96 + 96 = 192 hooks) to have same FRC cable lengths and to achieve design centering[5]. The connector numbering on the FRC cable is different for two cables (Fig. 2b). The textile design conversion software developed, converts the design file into binary format as per the module arrangement and cabling. The total power consumption of electronic jacquard is 75 W.

Software Tool for Name Plate Creation

The tool (Fig. 3) is used to automate the laborious process of creating name mats. This interface has been developed keeping in mind common users who may not be a specialist in designing the mat. Designer/weaver now has the flexibility to experiment new mat designs much more easily and quickly. Following algorithmic steps as shown in Fig. 4 are proposed by the authors to create the software tool [3,5,6]:

(i) Here 104 picks × 184 hooks is chosen as mat design area for name plate creation. Five hooks on either side are left for plain weave and to allow for selvedge, so effectively 174 hooks for creating names. Design of fonts and names is done with 52 picks (104/2), so that 1 by 1 mixing of inverted image of 52 picks can be carried out later to create required 104 picks design. The size of the mat design area remains customizable.

Fig. 3 — Name plate creation software for marriage mats

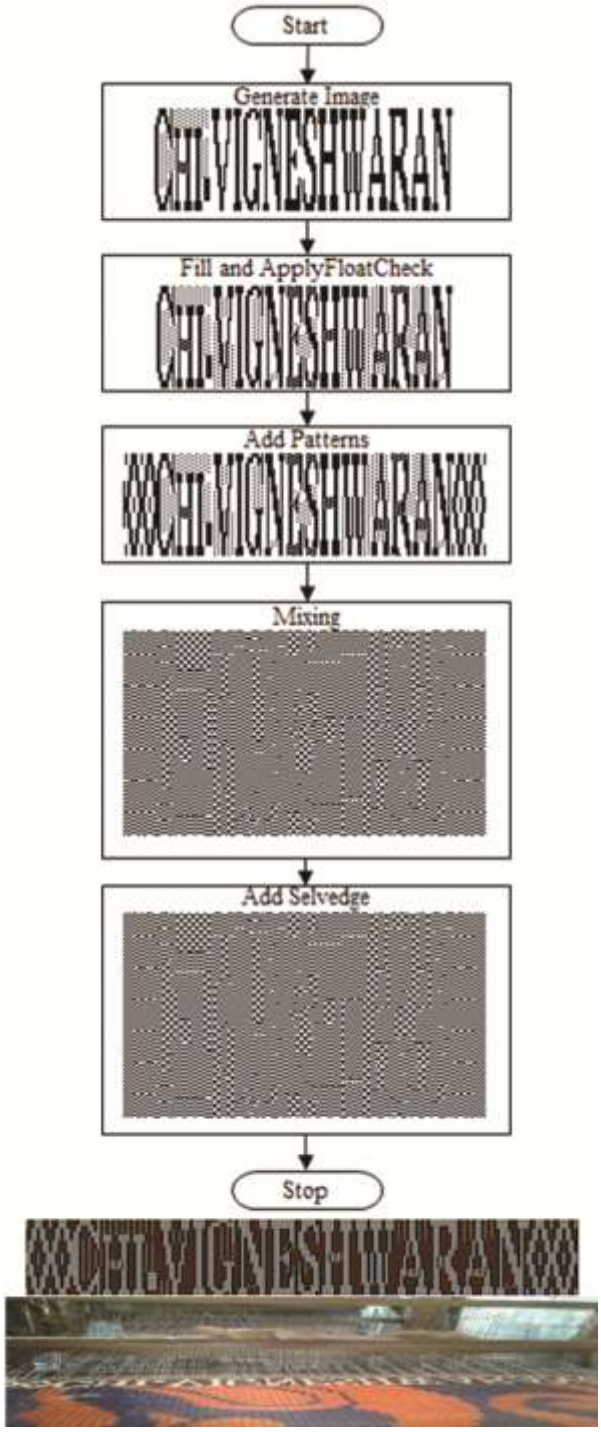

Fig. 4 —Flowchart and name design weaved on Korai mat

(ii) First, basic mat design is created with alphabets of any language (e.g. "CHI.VIGNESHWARAN"). Development of BMP files for the English individual alphabets and numbers from the graph sheet data provided by the weaver is carried out. For every English alphabet, a BMP file is created. Provision is provided to create new characters (other languages) of specific size.

(iii) File containing plain mat weave 3 by 1 (ground weave), for filling blank/ground area is prepared.

(iv) Software tool supports feeding of the name using three different methods. Method 1– Enter the number of characters [say 13 in the name CHI.VIGNESHWARAN]. Start selecting the bmp files stored in different folders (based on the language and font styles) for every character/number. It stops the selection as soon as the number of characters indicated is completed. Method 2 – On the bottom of the tool, weaver can enter the character sequence (name), he or she wants to weave. Then the tool automatically map letters / numbers to predefined filenames. Method 3 – Load the image directly into the panel. This is useful to weave mat designs instead of names.

(v) Next, user can center align the name and apply certain "pattern designs" like star to cover the empty area. This is done using the default or user selected files. Provision is provided to fill, left & right side of the name. New patterns can be added.

(vi) Next, ground weave (created in step 3) is applied on to the design to give the structure and strength to the mat.

(vii) Float check is performed and the correction to the image is provided automatically based on the predefined rules and provision is provided to edit and correct the bindings.

(viii) 1-by-1 mixing is carried out with the design obtained in the previous step with its inverted design to highlight the name over the background weft color (two color weft korai gross is used, one color for names and the other for background).

(ix) Simulation of mat design is generated (Fig. 4) based on the warp and weft density. Throughout the process, designer needs to visualize the image, so as to get the intuitive feeling of, the how the mat will look like after weaving. Simulation is helpful for such visualizations. Simulation works on the principle of image mixing[5] and scaling[7,8] with appropriate aspect ratio (4.7: 1, based on the ratio of picks per inch and ends per inch). Other important feature is zoom/edit, which helps the user to scroll to particular portion of mat and edit it manually.

(x) Plain weave is attached for 5 hooks on either side of design, to realize the selvedge.

(xi) Now the mat design is ready for production and can be saved in two file formats. Type 1 – Save the image in LMK[4] format to weave the mat with electronic jacquard. Type 2 – Save the file in BMP for further editing using other editors.

(xii) Divide feature – This is used to split 1-by-1 mixed image into 2 components. This is used after mixing to get the original mat design back.

The proposed systems (Fig. 5) has been developed, installed and commissioned successfully at Pathamadai, Veeravanallur near Tirunelveli Town, Tamilnadu and at Killimagalam, Kerala, India.

Adoption of electronic jacquard with pedaling mechanism to the mat weaving handloom and the name plate preparation software tool has resulted in:

- Weaving bigger motif designs and weaving of bride and bride groom name on the Korai mat meant for marriage occasion.
- The electronic Jacquard provides easy storage and retrieval of design and eliminates card punching for the design[9,10]. Simulation helps in visualizing mat and thereby allowing for more experimentation.
- Weavers could weave marriage mats, without designers support and could produce a full size design mat (3 feet width and 6 feet length) in

Fig. 5 — computerised Korai mat weaving handloom

2 days, which would otherwise have needed 6 - 8 days. Their earning improved to Rs. 600/- per mat from a meagre amount.

References

1 A Saravana Ganthi, M Yogaraj & M Padma Sorna Subramanian, *Nat Prod Radian*, 8(5) (2009) 542.

2 Muthiah S & Venkateswaran A, *Shanlax Int J Commerce*, 2(2) (2014).

3 Gokarneshan N, *Fabric Structure & Design* (New Age International Publishers, India), 2013.

4 Badari Nath K & Shantharam Nayak, *Int J Innovative Technol Res*, 4(4) (2016) 3139.

5 Badari Nath K & Shantharam Nayak, *Int J Innovative Technol Res*, 4(4) (2016) 3153.

6 Panneerselvam R G, *Indian J Fibre Text Res*, 38(2013) 186.

7 Roopa M R & Badari Nath K, *Int J Mech Eng Comp Appl*, 1(4) (2013) 70.

8 Revanur Ambareesh & Badari Nath K, *IEEE Int Adv Comp Conf, BMSCE, Bengaluru*, (2015) 754.

9 Mujumdar S, *Indian Text J*, 122 (Feb) (2012).

10 Ashis Mitra, *Indian Text J*, 121 (Oct) (2011).